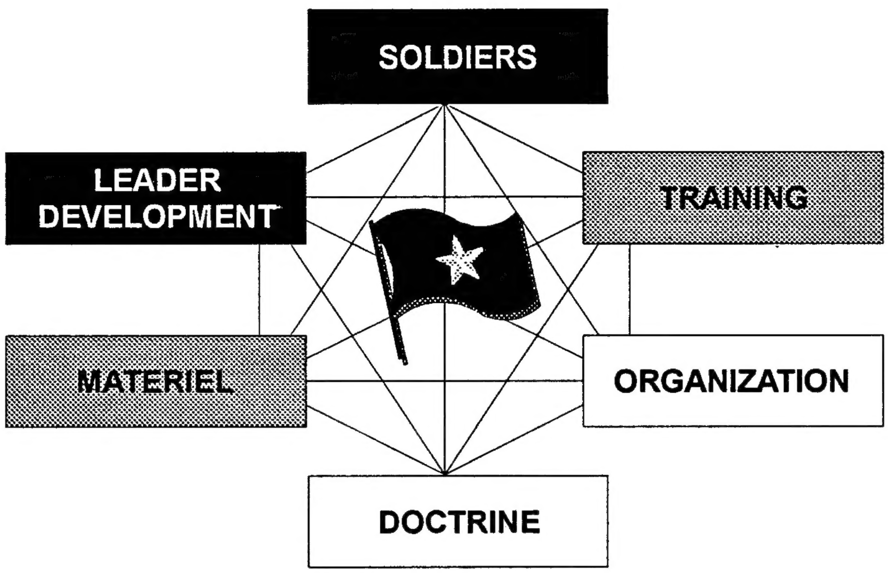
Mobile Strike Force Literacy Assessments: Implications for Force XXI



FY 95 Mobile Strike Force
Battle Command Experiment

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Introduction

Leader development requirements for a knowledge-based force in an information operations (IO) environment were examined by the Training and Doctrine Command (TRADOC) Analysis Center (TRAC) in the FY 95 Mobile Strike Force Battle Command Experiment (MSF/BC95). There were two types of requirements examined - those which are related to technology literacy and those related to multifunctional (branch and battlefield operating systems (BOS)) literacy. The study issue addressed by this paper is shown in the adjacent box. The specific essential elements of analysis (EEA) developed in the study plan to support this examination are shown below. The assessments for each of the two areas (technological literacy and multifunctional literacy) will be discussed in turn. Each section will present the methodology to answer these EEA and address this issue, and present the key study findings. Conclusions and recommendations for Force XXI leader development will follow.

> ◆ ***Issue: What are the observed leader development requirements for Information Operations?***

> ◆ ***EEA: What are the observed and perceived changes in the importance of current leader development competencies with the implementation of IO?***
>
> ◆ ***EEA: What shifts in institutional, operational assignment, and self development activities - the pillars of leader development - may be required to fulfill IO-oriented requirements for leader development?***
>
> ◆ ***EEA: What are the potential significant changes in leader development requirements as a result of employing envisioned IO concepts and capabilities?***

Technology Literacy

Command and General Staff Officer Course (CGSOC) students taking the Battle Command Elective (BCE) comprised the core of the staff of the Mobile Strike Force (MSF), a notional experimental unit for the Battle Command Battle Laboratory (BCBL) experiments in both 1994 and 1995. This elective grew from 28 to 73 in number of participants. In both years the AWE consisted primarily of CGSOC classes, simulation driven exercises, and the culminating CGSOC exercise, Prairie Warrior.

Observations made by the TRAC battle command support team during the FY 94 Battle Command Advanced Warfighting Experiment (BC AWE 94) indicated that computer and general technological literacy among the BCE students was not as high as generally hypothesized by members of the combat developments community. The level of student computer and technological literacy was hypothesized to be high by most personnel involved with the AWE, primarily based upon the presumed exposure of these personnel to information age technology and processes, both in prior operational assignments and at CGSOC. Furthermore, unless significant improvements are made in usability and ease of use beyond current prototype information technologies, a relatively high level of technological literacy will be required to adequately command Force XXI and staff it for decision support.

These issues of technological and multifunctional literacy began to be viewed as being in the realms of leader development and soldiers. Because of the late recognition of the problem in 1994, the methodology employed to address this issue in 1995 focused on data collection. The data collection effort was comprised of literature review, review of BCE 94 results, observation of BCE 95 activities, and BCE 95 student surveys. The focus of the data collection and analysis effort was the student surveys. Analysis of the data and information collected to address technological and multifunctional literacy linked these findings to findings resulting from other Force XXI leader development surveys. This linkage is explicitly detailed in the MSF/BC 95 Experiment Summary briefing.

Data Collection

- ***Literature review***
- ***Review of BCE 94 results***
- ***Observation of BCE 95 activities***
- ***Student surveys - BCE 95***

Literature Review. The literature review primarily led to the refinement of the survey tool to include identification of the leader development pillars contributing to literacy. This will be discussed below.

Review of BCE 94 Results. As previously stated, observations made by the TRAC battle command support team during the BC AWE 94 indicated that computer and general technological literacy among the 28 BCE students was not as high as generally hypothesized. Because this was not even considered to be an issue prior to the AWE, there was not a tool developed to capture data in this area during the 1994 AWE. However, the following observations were made by the study team and BCBL personnel. The *Windows* environment provided to the students was not well understood or easily used by the majority of the BCE students. Some students were at ease with the automated file transfer capability provided on the surrogate battle command support system; however, most were not comfortable with the process. Also, the process of deriving statuses from the system was not consistently understood. Furthermore, some hardware provided as part of the system, such as the tactical facsimile, was not familiar to all personnel. The team observed that there were significant problems using the tactical facsimile and fully exploiting the windows environment in the first scheduled simulation exercise (SIMEX). The problems were so significant that the second SIMEX was canceled to provide training on the computer systems. Although the term computer literacy was initially used to describe the area of concern, the problem was really one more of technological literacy, as evidenced by the lack of consistent competency on technology such as the tactical facsimile and the videoteleconferencing (VTC) capability. Finally, during the BC AWE 94 the TRAC team identified the fundamental knowledge-based force technologies to be automated planning tools, geographic information systems (GIS), and collaborative tools (e.g. VTC).

Technology Problems

- ***Windows Environment***
- ***File Transfer***
- ***Tactical Facsimile***
- ***Videoteleconferencing***

Observation of BCE 95 Activities. The study team observed all major BCE 95 activities. These included classes, seminars, Phoenix (the surrogate battle command support system used in the 1995 experiment) computer training, "brown-bag lunch" tactics, techniques, and procedures (TTP) development sessions, three SIMEXs, and Prairie Warrior (planning sessions and

end-of-course exercise for all CGSOC students). The purpose of these observations was to develop a complete picture regarding assessed student technology literacy. In 1994 although the study team observed all major events at the BCBL, CGSOC classes and seminars were not attended. Also, as mentioned above there was a lack of systems training in 1994. The study team determined that all the student activities needed to be observed to obtain complete and accurate information regarding technology and tactical literacy, and to gain more complete knowledge of the MSF and digitized battle staff concepts to appropriately analyze and evaluate both of them.

Observed Events

- ***BCE Classes***
- ***Seminars***
- ***PHOENIX Training***
- ***TTP Development***
- ***BCBL SIMEXS***
- ***Prairie Warrior***

Student Survey. Because of the concerns over the technological literacy of the current generation of CGSOC officers, which surfaced only as the result of chance observation during 1994, TRAC developed a survey to evaluate the technological literacy of the 73 BCE students in 1995. This survey is at the appendix. It was administered during the BCE on 5 January, 1995. A study team member administered the survey to each of the four sections of the BCE, answering any questions and making any clarifications required. The usual clarifications related to defining the term VTC, and providing examples of automated planning tools or GIS. Based on the limited number of total questions by the BCE students, the survey instructions were assessed as appropriate for administration of the survey to a control group without study team members present.

The distributions and means of the BCE students' responses are shown in Table 1 below. The survey results will be discussed further below.

	Totally Illiterate	Some Familiarity	Competent	Very Comfortable	Totally Literate	Mean of 1-5 Scale
VTC	25	29	10	6	3	2.08
COMM FAX	2	21	20	18	12	3.23
TACT FAX	16	34	12	5	6	2.33
Windows	3	19	20	20	11	3.23
DOS	6	28	18	12	9	2.86
Unix	47	20	4	1	1	1.48
Word Processing	1	8	22	24	18	3.68
Graphics	4	14	21	24	10	3.3
Spreadsheet	18	24	18	8	1	2.42
DBMS	17	32	15	8	1	2.23
Comms	13	29	16	12	3	2.49
Auto Plng Tools	47	17	7	1	1	1.52
GIS	53	18	2	0	0	1.3

N = 73

Table 1 - Distributions and Means of BCE Technology Literacy Self-Assessments

The survey was also administered to a control group selected at random (stratified by branch based on the branch structure of the BCE) by the Command and General Staff College

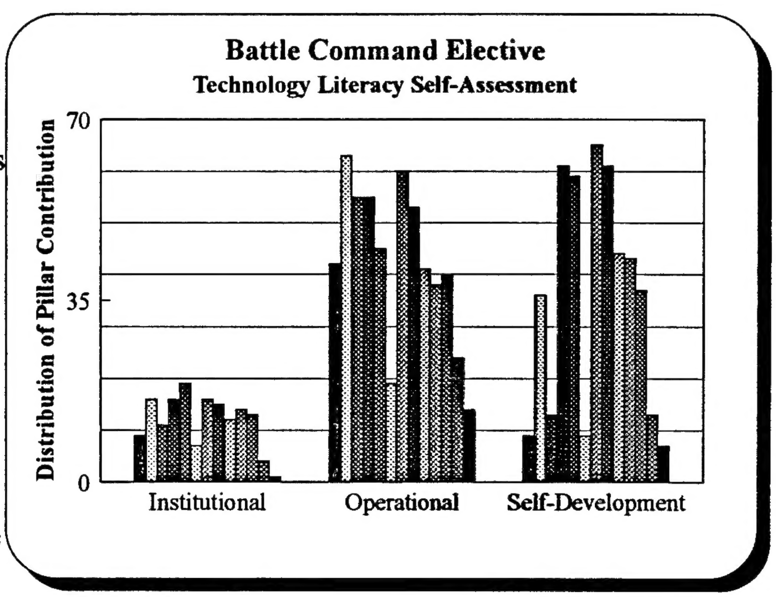
(CGSC). The survey (73 total) was distributed and returned through the CGSC internal mail. The first 38 surveys returned by the due date were used for comparison with the BCE. The decision to use these 38 was based on the fact that the branch structure of these returns proved to be statistically no different from the basic branch structure of the BCE. Editing of the 38 returns revealed the students had no serious problems understanding the survey without study team members present. There were several notations questioning what VTC and GIS were; however, given the limited number that there were among all the responses this only demonstrated reason for those respondents to mark totally illiterate for these technologies. Table 2 shows the distributions and means of the control group's self-assessments, by technology.

	Totally Illiterate	Some Familiarity	Competent	Very Comfortable	Totally Literate	Mean of 1-5 Scale
VTC	19	12	7	0	0	1.68
COMM FAX	0	4	14	14	6	3.58
TACT FAX	13	13	9	2	1	2.08
Windows	1	9	8	13	7	3.42
DOS	1	14	13	8	2	2.89
Unix	24	12	2	0	0	1.42
Word Processing	0	3	11	15	9	3.79
Graphics	2	11	11	10	4	3.08
Spreadsheet	9	14	7	5	3	2.45
DBMS	8	20	6	3	1	2.18
Comms	9	12	11	5	1	2.4
Auto Plng Tools	26	9	1	2	0	1.45
GIS	35	3	0	0	0	1.08

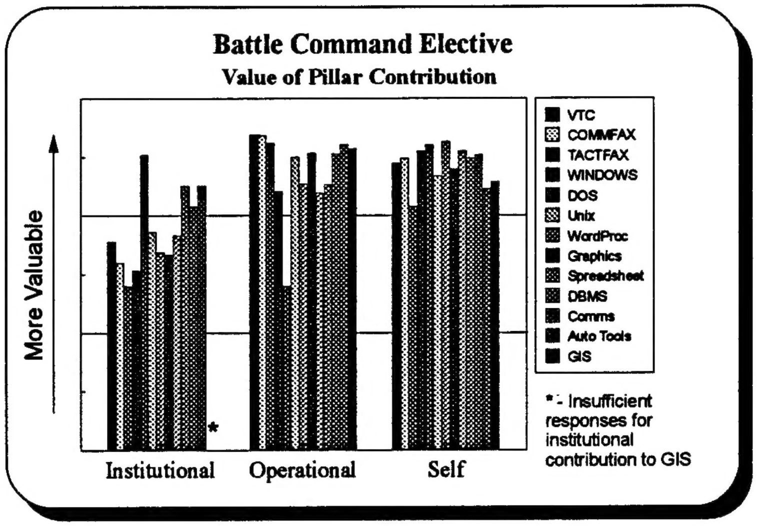
N = 38

Table 2 - Distributions and Means of Control Group Technology Literacy Self-Assessments

The survey also requested respondents to identify the leader development pillar(s) (institutional, operational, and self-development) which contributed to the assessed competency, regardless of level of competency. Besides identifying which pillars were contributory, the respondents were asked to rank the pillars' contributions. The first chart below shows the distribution of BCE students' responses as to the contributions by Army training pillars to the assessed level of competency for each technology (the individual bars on the charts represent, in order from left to right, the technologies shown from top to bottom in the table). The subsequent chart on the next page indicates that the operational and self-development pillars have contributed to individual technology competencies much more than the institutional pillar.



Thus, the chart indicates that those contributions of the institutional pillar were clearly less valued than those from the other two pillars. Note that the operational pillar was clearly the most valued except for the following technologies: Windows, DOS, word processing, spreadsheet and DBMS. The proliferation of personal computers and office automation suites of software are likely to be one reason for this result. Almost every member of the BCE had a personal computer for home use to support literacy development in these areas.



The technology literacy survey was administered a second time during the BCE on 25 April, 1995. The table below presents the results from that survey. Pillar contributions were not

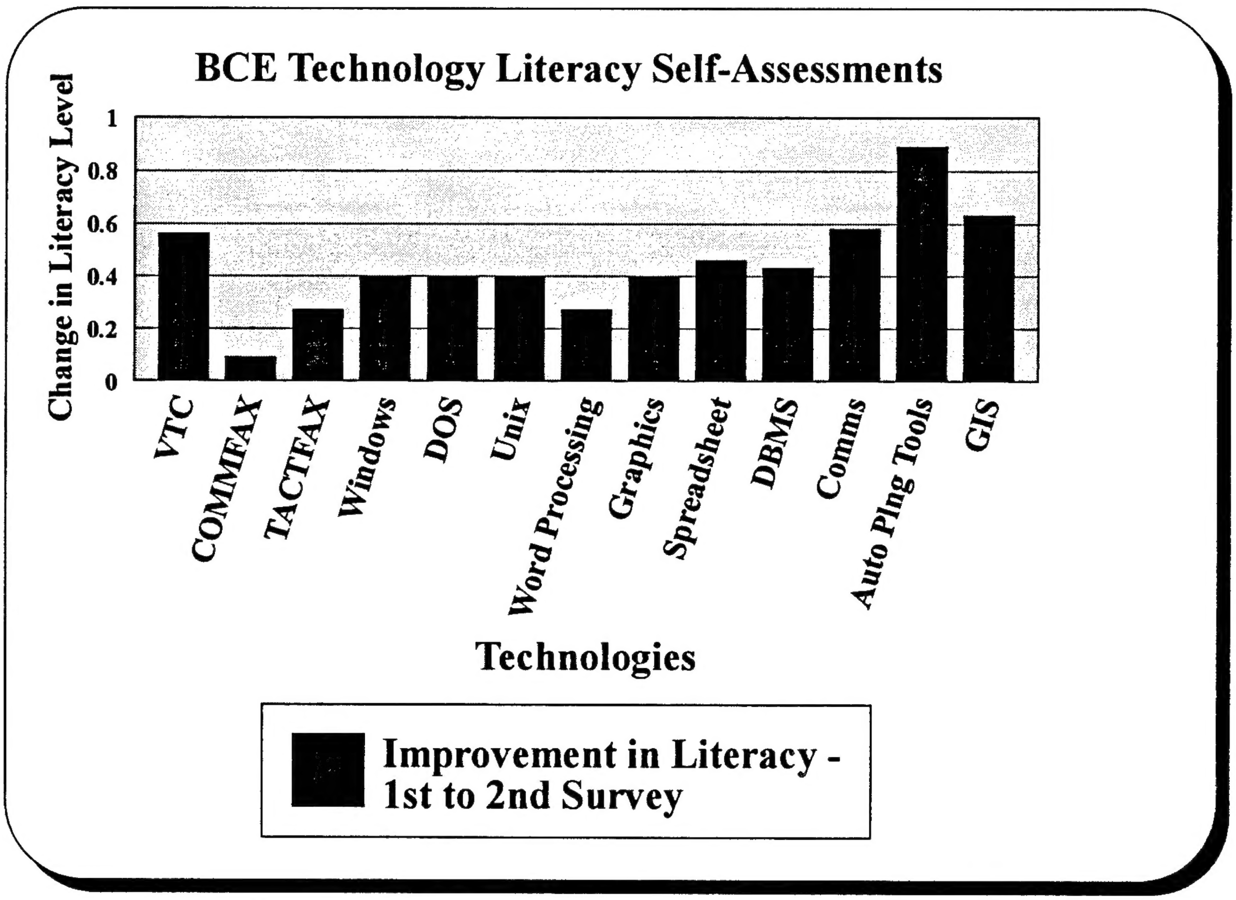
	Totally Illiterate	Some Familiarity	Competent	Very Comfortable	Totally Literate	Mean of 1-5 Scale
VTC	25	29	10	6	3	2.08
	5	31	24	11	2	2.64
COMM FAX	2	21	20	18	12	3.23
	3	15	21	24	10	3.32
TACT FAX	16	34	12	5	6	2.33
	10	29	18	12	4	2.6
Windows	3	19	20	20	11	3.23
	0	9	21	18	24	3.63
DOS	6	28	18	12	9	2.86
	1	21	18	24	9	3.26
Unix	47	20	4	1	1	1.48
	31	27	8	7	0	1.88
Word Processing	1	8	22	24	18	3.68
	0	5	14	34	20	3.95
Graphics	4	14	21	24	10	3.3
	0	10	16	33	14	3.7
Spreadsheet	18	24	18	8	1	2.42
	6	25	20	16	6	2.88
DBMS	17	32	15	8	1	2.23
	11	26	18	13	5	2.66
Comms	13	29	16	12	3	2.49
	4	21	21	20	7	3.07
Auto Plng Tools	47	17	7	1	1	1.52
	18	19	26	8	2	2.41
GIS	53	18	2	0	0	1.3
	29	27	11	5	1	1.93

N = 73

Table 3 - Distributions and Means of BCE Technology Literacy Self-Assessments (Re-Survey)

sought in this re-survey, and it was not re-administered to the control group. The re-survey was conducted to help assess the effect of the total BCE experience through SIMEX 3 on individuals' technology literacy. Both the distributions and means of the responses are shown in the preceding table, Table 3 above. The results of both technological surveys are shown in the table for comparison. The first row of data shown beside each technology are the results from the first survey, while the second row presents the second survey data.

There appeared to be a general rise in the level of the self-assessment of technological competency. To determine if there were a statistically significant difference in the two data sets, a difference of means test was performed. This test indicated that there was a statistically significant difference between the first and second survey data. The implication is that the experience of the BCE has had an overall positive effect on the technological literacy of the students. To more precisely isolate which technologies the BCE might have most affected, the difference in the means is shown in the chart below. The chart shows that the fundamental knowledge-based force technologies, VTC, automated planning tools, and GIS were among those in which competency changed the greatest, although this change was from absolutely low levels. This implies that the experience of the BCE had one of the desired effects upon the students, that of raising awareness and competency in these key technologies.



Key technological literacy findings. The key findings regarding technological literacy are listed below. Conclusions and recommendations for Force XXI will be presented in the last section of this paper.

- No statistically significant difference, at the 95 percent confidence level, existed between the responses of the BCE and the CGSOC as a whole, as represented by the control group. A paired difference of means test showed this to be true. The correlation between the two groups of means was also determined to be very high. Therefore, the BCE is appropriate to use as a representative sample of the CGSOC as a whole for this type of research.

- Three of the four lowest ranked competencies (GIS, Automated Planning Tools, and VTC) are the fundamental capabilities of a 21st century knowledge-based force. GIS, the lowest assessed competency, is the key technology for Force XXI command and control. This is because all digital map-based command and control systems are essentially GISs.

- Competency in the Unix operating system, which is the operating system for the BCBL's Phoenix system, was assessed as second lowest. This is a notable consideration only if the user interface available with the system is not reliable or stable and the operating system is directly encountered by the users.

- Word processing and graphics were assessed as first and second highest. This is likely a reflection of the usual exposure to office applications which introduces personnel to computer usage. Commercial facsimile and *Windows* were the next highest, and can be explained in this same vein.

- The major contributors to the technological competency which the BCE students have achieved have been the operational and self-development pillars. The institutional pillar has been a much less frequent contributor to technological competency than the other two pillars. Further, it was reported that the value of contribution of the institutional pillar, when it contributed, was the lowest of the three.

- The technological literacy re-assessment indicated that the BCE experience had the effect of raising the mean competency in all the technologies. It is given that there could have been interaction effects from the CGSOC as a whole during this period; however, if the key technologies are isolated the effect of the BCE is apparent. The change in competency with automated planning tools and GISs was significantly higher than all others.

Multifunctional Literacy

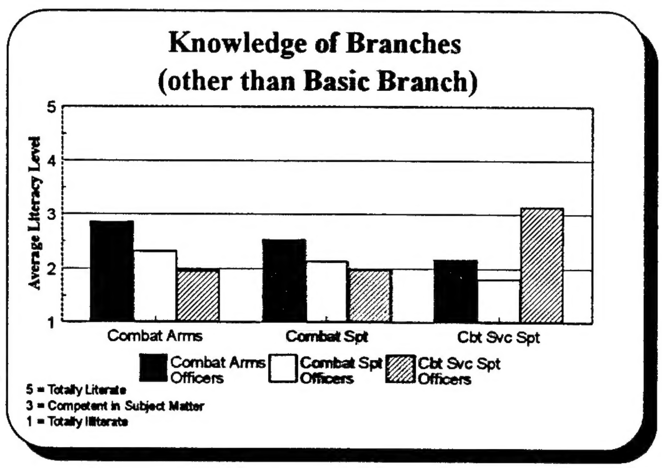
In November 1994 the BCBL made the decision to experiment with the digitized battle staff (DBS) concept in the 1995 experiment. In the past several years the concept of multifunctional or generic staff officers has appeared as an enabler to optimize automated battle staffs. The organizational and process changes explicitly or implicitly required by the DBS concept are not discussed in detail here; however the DBS concept which the BCE employed specifically depends on the use of multifunctional staff officers. The requirement for

multifunctionality of staff is explicitly stated in the concept and in several briefings the study team heard.

Although there was not an explicit data collection effort on multifunctional staff officers in the 94 AWE, there was no significant observed multifunctionality among the 1994 BCE students. The limit of multifunctionality appeared to be across several branches of a battlefield operating system (BOS), such as an infantry officer also having competency in the other maneuver branches or a quartermaster having competency in multiple combat service support branches. Triggered by the reiteration of the multifunctionality requirement during briefings of the DBS concept in 1995, and based on the limited degree of multifunctionality observed during the 94 AWE, TRAC decided to make this component a part of the overall literacy assessment. A tool was developed to examine the current level of branch and BOS multifunctionality among the students in the BCE. This survey was similar to that for technology literacy, except that the self-assessment of literacy is by branch and BOS.

This survey was an additional requirement to the BCE survey schedule and control over the returns could not be as tight due to individual students' class schedules. Therefore, the study team validated for use the surveys of the first 58 respondents, who both met the due date for return and correctly completed the survey. These first 58 had a branch structure which was the same as the entire BCE. The distribution and means of the responses are shown in Table 4 on the next page.

The branch/BOS literacy survey indicated that the BCE students are not currently multifunctional across more than the most closely related branches or BOS's. The data in table 4 illustrates variability of competency in branches and BOS's. Another way of looking at multifunctional literacy is through knowledge of branches other than an officer's basic branch. In the chart at right, the solid bars indicate the literacy level combat arms officers have regarding combat arms (other than their basic branch), combat support, and combat service support. Likewise, the literacy that combat support officers have about combat arms, combat support (other than their basic branch) and combat service support is shown by the white bars. Finally, the hatched bars provide CSS officer self-assessments of literacy in combat arms, combat support, and combat service support, again, other than in their basic CSS branch. The only area in which average literacy was above the "competent" level was in the knowledge of CSS officers about CSS branches other than their own. The next highest literacy level was in the knowledge of combat arms officers regarding other combat arms branches and combat support branches. Other areas of concern revealed by the coefficient of variation, another measure examined in the analysis, are air defense and chemical branches, where high variability and low mean competency indicated a lack of strong knowlege of these branches among the BCE students.

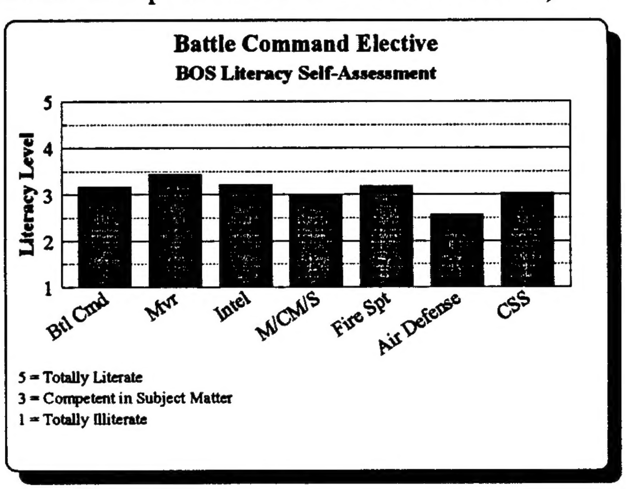


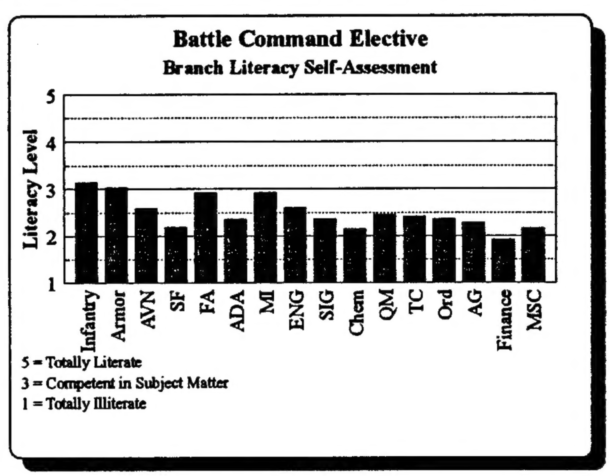
	Self Assessment Scale					
	Totally Illiterate	Some Familiarity	Competent in Subject Matter	Very Comfortable	Totally Literate	Mean of 1-5 Scale
BRANCHES:						
Infantry	1	17	19	15	6	3.14
Armor	2	20	18	15	4	3.03
Aviation	4	27	20	3	4	2.59
Special Forces	6	40	8	3	1	2.19
Field Artillery	5	18	20	6	9	2.93
Air Defense Artillery	7	31	15	2	3	2.36
Military Intelligence	2	24	16	8	8	2.93
Engineer	3	29	18	4	4	2.6
Signal	6	32	15	3	2	2.36
Chemical	8	36	12	2	0	2.14
Quartermaster	11	23	15	5	4	2.45
Transportation	10	25	15	5	3	2.41
Ordnance	12	25	12	6	3	2.36
Adjutant General	12	27	13	3	3	2.28
Finance	17	32	6	3	0	1.91
Medical Service	13	30	11	1	3	2.16
BOS:						
Battle Command	0	17	16	23	2	3.17
Maneuver	0	12	15	24	7	3.45
Intelligence	0	13	24	17	4	3.21
Mobility/Surviv-ability	1	18	24	11	4	2.98
Fire Support	1	15	21	14	7	3.19
Air Defense	3	30	17	5	3	2.57
Combat Service Support	2	18	19	14	5	3.03

N = 58

Table 4 - Distributions and Means
Branch/BOS Literacy Self-Assessments

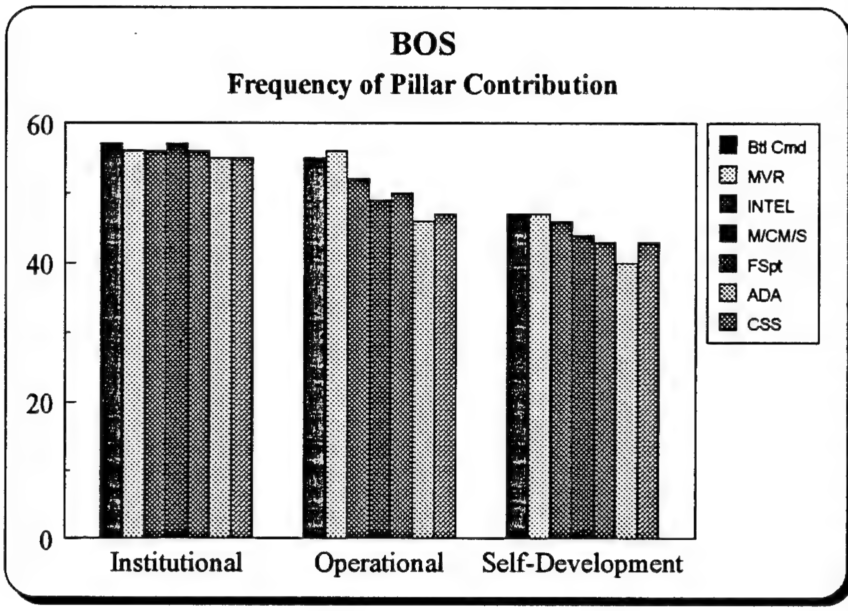
The next two charts show the means to indicate graphically the level of BOS and branch competencies as self-assessed by the BCE. Observations corroborated the survey results. Only infantry and armor had a mean assessment of competent or better, although only two of the seven BOSs failed to do so. Because there are usually multiple branches associated with a single BOS, it may have been easier for the students to assess their competency higher across the BOSs than across the spectrum of branches. However, the study team was most interested in determining

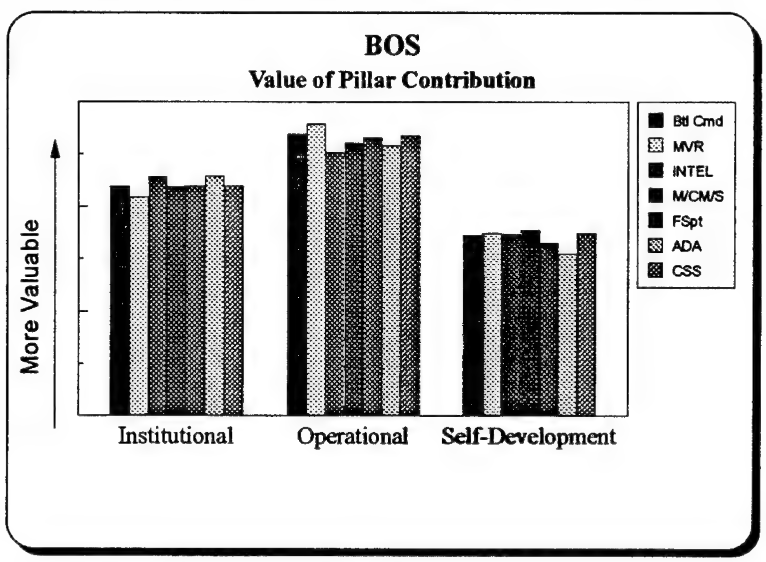


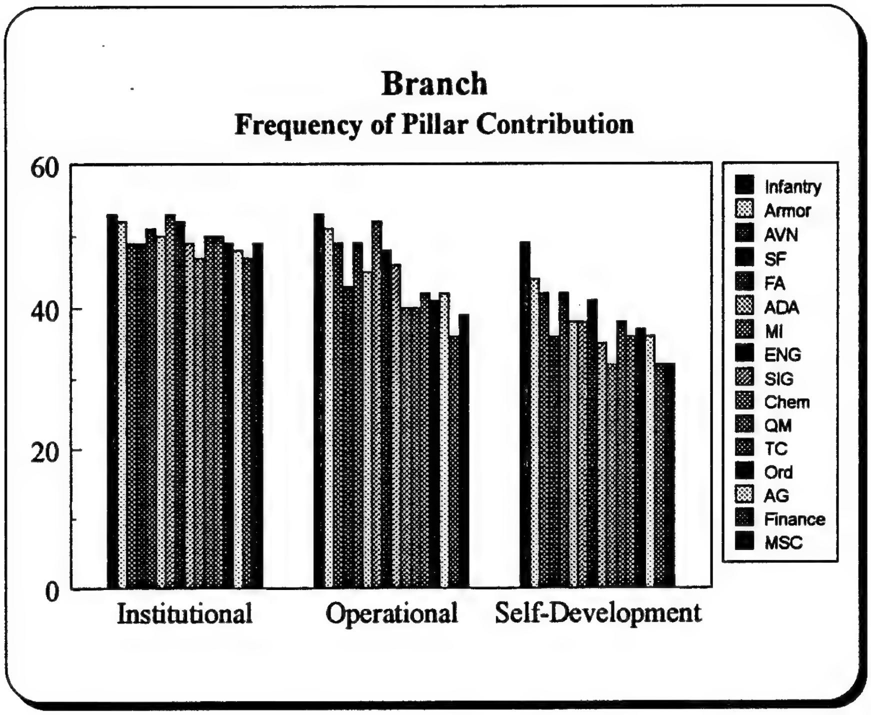


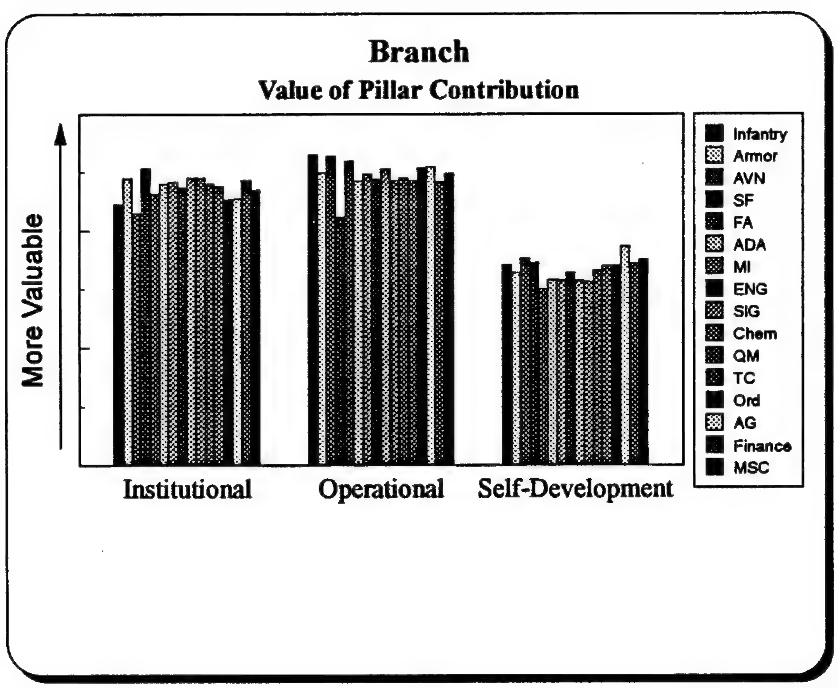
not that there was some general low level of competency across branches or BOSs among the representative group, but whether there is a definite lack of multifunctionality existing among our leaders today.

The leader development contribution by pillar to BOS and branch competency is shown by the subsequent four charts. BOSs and branches are illustrated in the same order as above. Again, the interpretations are similar to those for the technology literacy responses. The frequency charts show the number of times out of 58 that a pillar was marked as contributing to branch or BOS competency. The value charts show which pillars were valued higher in contribution. Of note here is that the operational pillar is the most valued for both branches and BOSs. The institutional pillar was marked as the one of the three most often contributing to branch and BOS competency. This reflects the fact that it is the institutional pillar which is responsible for formal development of literacy in branches and BOSs. Note the result from the survey that self-development was the least valued pillar for both BOS and branch competency. Moreover, this pillar was significantly less valued across the board, indicating one of two things - that the students either do not find self-development valuable or they are simply ranking it third consistently. This is probably a result of the emphasis placed upon officers during this period in their career relative to operational experiences and certain institutional ones (e.g. CGSOC).






Branch
Frequency of Pillar Contribution
60
40
20
0
Institutional
Operational
Self-Development
Infantry
Armor
AVN
SF
FA
ADA
MI
ENG
SIG
Chem
QM
TC
Ord
AG
Finance
MSC


Branch
Value of Pillar Contribution
More Valuable
Institutional
Operational
Self-Development
Infantry
Armor
AVN
SF
FA
ADA
MI
ENG
SIG
Chem
QM
TC
Ord
AG
Finance
MSC

Key multifunctional literacy findings. The key findings regarding multifunctional literacy are listed below. Conclusions and recommendations for Force XXI will be presented in the subsequent section.

- The multifunctional self-assessments and observations of the BCE students indicated that the officer corps is not currently multifunctional across more than the most closely related branches or BOSs.

- The combat service support branches were generally low ranked. The competency among members of the MSF in the CSS branches was also highly variable, reflecting a lack of cross competency into the logistics arena. Chemical and special forces were also low ranked, but as opposed to the CSS branches, were not highly variable. This indicated very little other than specialist competency available for these branches within the MSF.

- Air defense, the lowest ranked BOS, was also the most variable. This indicated a significant lack of cross competency into this BOS.

- The major contributors to branch and BOS competency of the BCE students have been the institutional and operational pillars. The institutional pillar has a slight edge in frequency of contribution, and the operational pillar was noted as the most valuable. The self-development pillar has been a less frequent contributor to branch competency than the other two pillars. Further, it was reported that the value of contribution of the self-development pillar, when it contributed, was significantly lower than the other two.

Conclusions

The focused effort to assess technological literacy proved to be extremely valuable. The information obtained by survey regarding the degree of individuals' competency in the various technologies and the sources of that competency provides the Army leadership with a baseline methodology and data set for further research in this area. The findings refute some commonly held notions that living in the environment of the information age society alone will take care of much of the problem of becoming technologically literate to the degree required of leaders in Force XXI.

The effort to assess multifunctional literacy also proved to be highly valuable. Given the fact that the notion of multifunctional or "generic" staff officers surfaces periodically as part of a solution to reducing staff through automation, the results of the survey and corroborating observations are very timely. The fact that the Army has not developed multifunctional officers who can perform many branch or BOS functions and tasks competently does not mean it has failed to accomplish this mission previously. The development of multifunctional officers has not been required. However, the degree to which officers are multifunctional at this point in time, and the identification of the source of that competency, are powerful pieces of information for the Army leadership determining the role of leader development in Force XXI.

Recommendations

There are several major recommendations which can be made as a result of this study effort. These are listed below.

- **Competency in the fundamental knowledge-based force technologies - automated planning tools, GIS, and VTC - must be increased.**
- **Cross competency in multiple branches and BOSs must be increased.**
- **The institutional pillar must be strengthened to contribute more often and more valuably to the development of technological competencies.**
- **Emphasis on the self-development pillar may be essential in attaining multifunctional literacy.**

APPENDIX

Battle Command Elective
Technology Literacy Self-Assessment

1. Please take no more than five minutes to complete the attached survey. The purpose of the survey is to develop an overall general assessment of the class members regarding their competency in several technologies which we view as key to battle command.

2. a. Put your name at the top of the form.

b. Check the block for each technology which best describes your level of skill or competency with that technology in general. Totally illiterate should be construed as not being able to work using the technology, whereas totally literate should be construed as being able to train others in all aspects of that technology relevant to battle command.

c. Please list specific automated planning tools and geographic information systems you have used in the space provided at the bottom of the form. (If you do not mark totally illiterate, indicate the system(s) in which you have experience).

3. There are three institutional pillars to the Army training system. These are institutional training (e.g. TRADOC schools, civilian educational institutions), operational assignments (on-the-job) and self development (include correspondence and any at home work with the technologies not directly related to a work assignment at that time). Use a rating scale of 1 to 3 (1=high, 3=low) to indicate the relative predominance of the pillars in contributing to your competency in each technology. From one to three pillars may be checked for each technology which is not marked as totally illiterate. If you check totally illiterate for a technology, check the source of training if you have received training in that area.

4. An example completed form is attached.

NAME:

		Self	Assessment	Scale		Where	Acquired	Competency
Technologies	Totally Illiterate	Some Familiarity	Competent with Technology	Very Comfortable	Totally Literate	Institutional	Operational Assignments	Self Development
VTC								
Fax:								
Commercial								
Tactical								
Operating Systems:								
*Windows**								
DOS								
Unix								
Application Software:								
Word Processing								
Graphics								
Spreadsheet								
DataBase Management								
Communications								
Automated Planning Tools[1]								
Geographic Information Systems (GIS)[2]								

* Includes Microsoft Windows and all Windows-like environments

[1] Automated Planning Tools Used: ____________________

[2] GIS Tools Used: ____________________

NAME: MICHAEL INGRAM **EXAMPLE**

	Self	Assessment	Scale			Where	Acquired	Competency
Technologies	Totally Illiterate	Some Familiarity	Competent with Technology	Very Comfortable	Totally Literate	Institutional	Operational Assignments	Self Development
VTC		X					1	
Fax:								
Commercial			X				1	
Tactical		X					1	
Operating Systems:								
*Windows**				X		3	2	1
DOS				X			2	1
Unix		X					1	2
Application Software:								
Word Processing				X			1	2
Graphics			X				1	2
Spreadsheet			X				2	1
DataBase Management		X				1	2	3
Communications		X					1	
Automated Planning Tools[1]	X							
Geographic Information Systems (GIS)[2]		X				1		

* Includes Microsoft Windows and all Windows-like environments

[1] Automated Planning Tools Used: ____________

[2] GIS Tools Used: ERDAS, ARC INFO